DOCUMENT RESUME

ED 037 372 SE 008 242

AUTHOR	Smith, John P.
TITLE	The Development of a Classroom Observation Instrument Relevant to the Earth Science Curriculum Project.
INSTITUTION	Washington Univ., Seattle. Coll. of Education.
PUB DATE	Mar 70
NOTE	14p.; Paper presented at Annual Meeting of the National Association for Research in Science Teaching (43rd, Minneapolis, Minne., March 5-8, 1970)
EDRS PRICE	EDRS Price MF-$0.25 HC-$0.80
DESCRIPTORS	*Classroom Observation Techniques, *Earth Science, *Evaluation, Research Methodology, Secondary School Science, *Teacher Characteristics
IDENTIFIERS	Earth Science Curriculum Project

ABSTRACT

A classroom observation instrument was developed for investigating teacher and student behaviors associated with the maintenance of an inquiry atmosphere where Earth Science Curriculum Project materials are used as a course of study. This instrument was later used in ESCP classrooms to determine its reliability and usefulness in describing teacher and student philosophy and objectives. Teacher and student behaviors were grouped into four major categories consistent with situations expected to occur in ESCP classes, i.e., developing text materials, pre-laboratory, laboratory, and post-laboratory discussion. Seven judges, selected from a list of ESCP writers and trial teachers, were asked to rate each item as (1) consistent with ESCP, (2) neutral, or (3) inconsistent with ESCP. Classroom observations based on the instrument developed for this study were made of six ninth-grade ESCP teachers in three junior high schools. The results of the study were analyzed to describe teachers relative to ESCP and to develop ideas for future research. (BR)

THE DEVELOPMENT OF A CLASSROOM OBSERVATION INSTRUMENT RELEVANT TO THE EARTH SCIENCE CURRICULUM PROJECT

John P. Smith
University of Washington

INTRODUCTION

Beginning with the work of the Physical Science Study Committee (PSSC) in 1956, the science reform movement of the past decade has resulted in a number of new secondary school curricula which have become familiar in many classrooms across the nation. The teaching-materials packages developed by the various curriculum committees are characterized by: (1) an organization of content (or as in BSCS three different organizational emphases) broadly representative of the structure of the discipline as seen by the research scientist, (2) new goals and objectives including processes of science as well as current scientific knowledge, and (3) suggested methods of instruction consistent with the inquiry aspects of the respective scientific disciplines.

RATIONALE

Designers of the experimental science curricula contend that the method of instruction employed by a teacher, e.g., the inquiry approach, contributes significantly to what is learned. The result has been the development of science curricula demanding special ways of teaching to achieve their respective goals. As the new curricula grow in number, the need for studies describing

the teacher's behavior in implementing a new curriculum becomes apparent. Previous models for curriculum evaluation have not provided the answers. The practice of comparing student achievement in an experimental science curriculum with student achievement in a traditional science course does not identify the classroom conditions under which an experimental curriculum does or does not achieve its objectives.

Hilgard[1] stated there is a need for research investigating the teacher's "strategy of innovation" in implementing a new curriculum. He was concerned that in the process of innovation teachers not party to the experimental tryouts of a new curriculum may fail to use equipment and available resources or to adequately interpret suggested teaching styles.

Classroom observations support Hilgard's concerns. After visiting classes where the new physics was taught with an inappropriate emphasis on the presentation and memorization of facts, Tyler[2] concluded that there is a need for studies describing what occurs in classrooms where experimental curricula are used. Pella's visits to classrooms where nationally developed science curricula were taught resulted in observations similar to Tyler's. Pella[3] found that course work still focused on memorization of facts with little attention to concept development--a major goal of the recently developed science curricula.

PROBLEM

The purpose of this investigation was to develop an observation instrument for collecting data on teaching performances under carefully specified conditions involving the teacher, a new science curriculum, and students. The Earth Science Curriculum Project (ESCP) was selected for the study as representative of a course planned by a national curriculum committee.

Development of the Observation Instrument

The first step in the development of the observation instrument was to review journal articles describing ESCP; ESCP Newsletters; the ESCP Teacher's Guide-Investigating the Earth, Parts I and II; and the ESCP text--Investigating the Earth. The purpose of the review was two fold: (1) to identify statements suggesting specific teacher and student behavior expected as part of the ESCP approach; and (2) to identify assertions having important implications for teaching ESCP but not expressed in terms of teacher and student behavior. The frequent reference to teaching ESCP as inquiry fell into this latter category. Since inquiry as behavior is not well defined, works by Beveridge[4] on the art of discovery and Schwab[5] on inquiry were reviewed for the purpose of identifying the scope of inquiry in science. Using the inquiry theme as the major focus in developing the ESCP observation instrument, a list was compiled of statements relevant to inquiry. As a guide for selecting inquiry relevant

statements, inquiry was defined as that behavior requiring or demonstrating student involvement with selected earth science problems either in class discussions or in student investigations.

To obtain classroom examples of inquiry behavior, observations and audiotapes were made of two ESCP classes during the 1968 summer school session. One teacher observed was a geology major with experience as a trial teacher of ESCP. The other teacher, a biology major, had attended an ESCP institute and had one year of ESCP teaching experience. It was felt that the behavior observed would be representative of kinds one might hope teachers and students would demonstrate during the regular school year.

The inquiry relevant statements obtained from the review of the ESCP literature described above and examples of teacher and student behavior from observer notes and tapes of ESCP classes were used as a basis for writing behavior items for inclusion in the observation instrument.

Each item was viewed as a potential indicator of one of two categories of behavior: (1) behavior consistent with maintaining the inquiry atmosphere of the ESCP approach and (2) behavior incompatible with the ESCP inquiry approach. Behavior descriptions were written to make assignment to one of the categories as unambiguous as possible. Teacher and student behavior were grouped into four categories consistent with situations expected to occur in ESCP classes, i.e., developing

text material, pre-laboratory, laboratory, and post-laboratory discussion.

The preliminary list of 107 items was evaluated by six judges selected from the list of ESCP writers and trial teachers found in the ESCP Teacher's Guide, Part I. These judges were asked to rate each item on a three point scale as either (1) consistent with ESCP, (2) neutral, or (3) inconsistent with ESCP. A median value and interquartile range was computed for the judges' ratings of each item. An item was not retained if its interquartile range (IR = $Q_3 - Q_1$) was greater than that of 51% of the items with the same median or if its interquartile range was equal to or greater than could be obtained by chance.

Ninety-one items representing behavior consistent with, neutral to, and inconsistent with ESCP were retained from the original list of 107 items. (One item was added by the author to obtain desired information about post-laboratory discussions.) Items were placed in subcategories within the categories of developing text material, pre-laboratory, laboratory, and post-laboratory discussion.* The final form of the observation instrument is shown in Appendix A. Items appearing in the instrument have been condensed by reducing words to distinctive letters and by eliminating all but "key" words. For example,

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*For a complete description of the ESCP observation instrument please write to the author, College of Education, University of Washington, Seattle, Washington 98105.

item A1, "Teacher distinguishes between fact and theory" appears on the instrument as "T dst btw fact & thry."

PROCEDURE

Classroom observations using the instrument developed for this investigation were made during Spring, 1969, of six 9th grade ESCP teachers in three junior high schools near Stanford University. Teachers were assigned to either the Training Group or the Study Group.

Teacher Characteristics

Four of the six teachers observed were in their second year of teaching ESCP. The remaining two were teaching ESCP for the first time. All but one teacher had attended a local ESCP workshop or ESCP institute prior to teaching the course. (See Table I for a summary of teacher background.)

TABLE I

Summary of Teacher Background

Teacher	Number of years ESCP experience	Training in ESCP methods prior to teaching ESCP	Undergraduate major	Earth Science units (semester)
A	2	Local ESCP Workshop	Chemistry	9
B	1 semester	Local ESCP Workshop	Biology	4
C	2	Local ESCP Workshop	Biology	0
D	2	Local ESCP Workshop	Biology	11
E	1 semester	None	Biology & Chemistry	3
F	2	ESCP Institute	Biology	20

Student and Classroom Characteristic

In each of the three junior high schools, ESCP was required of all 9th grade students. The teachers reported that their students' abilities ranged from low to high and that students' interests were quite varied. Students were not homogeneously grouped by class. Classes ranged in size from 25 to 30 students. Teachers reported that present classroom facilities and earth science investigation kits were, for the most part, adequate for teaching ESCP.

Observer Characteristics

Each of the six observers participating in the investigation was a graduate student in science education at Stanford University and an experienced science teacher although none had ever taught or observed ESCP classes before this investigation. Experienced science teachers were chosen as observers because of their familiarity, in general, with the expected classroom settings, for their understanding of science concepts, and for their familiarity with the terminology used in the observation instrument.

Observer Training

The training of observers was accomplished in three phases: (1) individual study of the behavior items, explanations, and examples one week prior to the first formal group training session, (2) a group training session with semi-programmed observer manual and selected audiotapes of ESCP classes, and (3) classroom experience using the observation instrument.

In phase three, observers were assigned to one of three teams. Pairings were made on the basis of convenience to the observers. Each team observed one of the three ESCP teachers (A, B, & C) in the Training Group for one 50 minute period each day for a period of eight days.

During classroom training each observer recorded his observations independently of the other member of his team. Immediately following each class period observers discussed and resolved

discrepancies in their records; however, the records were not changed. Because of the difficulty experienced in identifying ESCP investigation activities during initial observations (many ESCP investigations may be done at the student's desk) each observer was allowed to refer to a copy of the ESCP text, Investigating the Earth as an aid to identifying laboratory settings.

Inter-Observer Agreement

Immediately following the training period, the three teachers (D, E, & F) and their classes comprising the Study Group were observed for one 50 minute period per day for ten consecutive days. During this time, observers were rotated among teachers and observer teams. The interobserver agreements reported below were based only on data from observations of the study group. Inter-observer agreement for the observation period was determined by the formula

$$P = \frac{\text{number of agreements}}{\text{number of agreements} + \text{number of disagreements}} \times 100,$$

i.e., where P equals percentage agreement. When observations for all teachers were pooled across classroom settings, inter-observer agreement (two observers at a time) was P = 74%. Percentage agreements by classroom setting were: Developing Text Material, P = 70%; Pre-Laboratory, P = 87%; Laboratory, P = 75%; and Post-Laboratory Discussion, P = 79%.

When the frequency with which individual items occurred

was ignored, and only observer agreement as to the occurrence or non-occurrence of an item considered (each agreement counted as one and each disagreement counted as one), then, using the same formula as above, over-all inter-observer agreement was P = 87%.

RECOMMENDATIONS FOR RESEARCH

It is proposed that trained observers using the ESCP observation instrument record the behavior of a large sample of ESCP teachers for the purpose of making generalizations about "how" the Earth Science Curriculum Project is presented in classrooms. The investigation of a large sample of ESCP teachers would enable the investigator to study the relationship between different categories of teacher verbal behavior and student behavior and the implications observable student behavior have for learning concepts, processes, and attitudes.

RECOMMENDATIONS FOR TEACHER TRAINING

The identification of teacher behavior relevant to a curriculum is essential as a basis for describing specific aspects of teacher behavior as opposed to the general practice of talking about "good" teaching or "bad" teaching. As a device for use in teacher training, this instrument is considered useful at two levels. (1) As a tool in the preservice training of ESCP teachers, the instrument identifies behavior consistent with

ESCP that could be maximized during preparation for teaching ESCP. It also identifies behavior inconsistent with ESCP that one would expect to minimize during teacher training. (2) As an instrument for observing teachers where ESCP is already an accepted part of the school program, it may be used to identify current practices of teachers.

SUMMARY

An instrument has been developed for the identification of teacher and student behavior relative to the Earth Science Curriculum Project. The emphasis on behavior enables one to say in what ways teacher and student behavior is consistent with the intended ESCP approach rather than to say only that teaching is "generally" consistent or inconsistent with the intent of ESCP. Because it contains descriptions of teacher and student behavior, the instrument should be useful in the training of prospective and inservice ESCP teachers and as a basis for investigating the teaching behavior of ESCP teachers. The approach used in identifying behavior consistent with the ESCP philosophy may also be considered as a model of how teachers (either preservice or inservice) may better identify what is expected of them when adopting a new curriculum.

Appendix A

DEVELOPING TEXT MATERIAL

Teacher: _____ Date: _____ Observer: _____ Class Period: _____ School: _____

PRE-LABORATORY

TEACHER	Tot
AO (Nat of ES)	
A1 T dst btw fact & thry	
A2 T str tent nat of knldge in ES	
A3 T emp hist dev of knldge in ES	
A4 T exp hw info is obt in ES	
A5 T ident unslvd prob in ES	
BO (T Ques Rel to S Proc	
B1 T aks S to exp why sm phen occd	
B2 T aks S to spec abt fut or pst phen	
B3 T aks S to def nw wds in txt	
B4 T aks S to mem na of obj or str	
B5 T aks S to mem cls of obj or str	
B6 T aks S ques req Y or N ans	
CO (Resp to S Ques	
C1 T ref S ques bk to S	
C2 T ans S ques w anlgy	
C3 T resp S ques w "I dn't knw"	
C4 T gvs dir ans to S ques	

TEACHER	Tot
EO (Ident of Prob f Invest)	
E1 T aks S to st prob to be invest	
E2 T aks S to st pur of invest	
E3 T aks S to rel invest pre wk	
E4 T st prob to be invest	
E5 T rel invest to pre wk	
E6 T condt dem rel to invest thme	
FO (Dir on Condt of Invest)	
F1 T gvs S-b-S dir f per invest	
F2 T disc pot'l diff in lab pro	
F3 T exp hw to mk meas	
F4 T exp hw to wk math prob	
F5 T aks S to prep wrt rep of invest	
F6 T mk st abt saf prec	

STUDENT	Tot
DO (S Proc St)	
D1 S exp why sm phen occd	
D2 S def nw wds usd in txt	
D3 S nam obj or str	
D4 S clsfy obj or str	
D5 S resp to T ques w Y or N ans	
D6 S obs obj or str	
D7 S st hyp	
D8 S use S/T rel in exp'n or des'n	
D9 S rel nw info to tpc of disc	
D10 S ident prob f poss invest	

STUDENT	Tot
GO (Ident of Prob f Invest)	
G1 S rests invest thme des by T	
G2 S st purp of invest	
G3 S rel invest to pre wk	
G4 S st own prob f invest	
HO (Dir on Condt of Invest)	
H1 S pro w invest w/o dir fr T	
H2 S rd aloud dir f invest	
H3 S req clar of lab dir	

Appendix A (cont.)

LABORATORY

Teacher: _____ Date: _____ Observer: _____ Class Period: ___ School: _____

TEACHER	Tot
IO (Ident Crit Asp of Invest)	
I1 T aks S to obs sm obj or phen	
I2 T aks S to des sm obj or phen	
I3 T aks S to exp why or hw sm phen occd	
I4 T des obs S shd mk	
I5 T exp why or hw sm phen occd	
I6 T tls S proc is wrg	
I7 T sits at dsk or lvs rm	
JO (Resp to S Ques Abt Invest Proc)	
J1 T resp to S ques w pro f ans ques	
J2 T ans S ques abt invest proc w anlgy	
J3 T ref ques abt invest proc bk to S	
J4 T gvs dir ans abt invest proc	
J5 T per pt of invest f S in res to ques	
J6 T sys or ds not in res to S ques	
KO (Eval)	
K1 T grds S on lab proc	
K2 T aks ldg ques to eval wk	
K3 T mvs fr sta-t-sta	

STUDENT	Tot
LO (Ident Crit Asp of Invest)	
L1 S mk own obs	
L2 S aks f hlp w invest proc	
L3 S prep wrt rep of invest	

POST-LAB DISCUSSION

TEACHER	Tot
MO (Dat Red)	
M1 T aks S to gr or othrw org dat	
M2 T tls S hs res are incor	
M3 T wks math prob f S	
NO (Interp of Res of Invest)	
N1 T aks S to comp res amg selv	
N2 T aks f div interp of res	
N3 T aks S to ident reg in dat	
N4 T aks S ident sor or er/var in dat	
N5 T aks S to st concl	
N6 T aks S sup concl w evid fr invest	
N7 T aks S to rel concl to pst res	
N8 T aks S to mk pred fr res	
N9 T aks S to prop invest sug by res	
N10 T ident sor of er/var in dat	
N11 T des concl sh ded fr res	

STUDENT	Tot
OO (Dat Red)	
O1 S gr or othrw org dat	
O2 S aks T if res are cor	
PO (Interp of Res of Invest	
P1 S comp res amg selv	
P2 S disc div interp of res	
P3 S ident reg in dat	
P4 S ident sor of er/var in dat	
P5 S st concl	
P6 S sup concl w evid fr invest	
P7 S rel concl to pst res	
P8 S mk pred fr dat	
P9 S prop invest sug by res	
P10 S aks if concl are cor	
P11 S aks T wh concl sh be ded	
P12 S try rech cons on interp res	

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